OFFICE OF SCIENCE & TECHNOLOGY

Characterization,
Monitoring,
& Sensor
Technologies

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Progress Reports

Characterization,
Monitoring,
& Sensor Technology
Crosscutting Program

Federal Energy
Technology
Center,
Morgantown

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FETC Index

This index lists FY97 FETC projects by number, name, and document location of brief descriptions of their major activities for the month. It also identifies which technologies the project involves. ("**P**" indicates primary involvement.)

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AC21-92MC29101	High-Resolution Subsurface Imaging and Neural Network Recognition		**P**				
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AR21-96MC33077	Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography, and Ground Penetrating Radar	3	**P**				
AR21-96MC33079	Internal Reflection Sensor for the Cone Penetrometer		**P**				
AC21-96MC33124	*In Situ* Permeability Measurements with Direct Push Techniques	2	**P**				
AC21-96MC33125	Subsurface Barrier Validation with the SEAtrace™ Monitoring System	10	**P**	✓			
AC21-96MC33128	*In Situ* Tritium Beta Detector	7	**P**				
AC21-92MC29108	Field Raman Spectrograph for Environmental Analysis		✓	**P**	✓	✓	
AR21-93MC30363	Robotic End Effector for Inspection of Storage Tanks	12		**P**			
AR21-95MC32087	An Advanced, Open-Path, Atmospheric Pollution Monitor		✓	**P**			
AC21-96MC33126	Automated Monitoring System for Fluid Level and Density in High-Level Waste Tanks			**P**			
AC21-92MC29115	Intelligent Inspection and Survey Robot	20			**P**	✓	
AC21-93MC30173	Waste Inspection Tomography	17	✓		**P**	✓	
AC21-94MC31191	Automated Baseline Change Detection	20			**P**		
AC21-96MC32194	A Continuous Emission Monitor for Toxic Metals in the Offgases of Thermal Treatment Facilities				**P**		
AC21-96MC33127	Nondestructive Examination and Assay of Drums Containing Transuranic Waste	18			**P**	✓	

FETC Index - continued

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AC21-93MC30172	Characterization for Radioactive Contamination Inside Pipes with the Pipe Explorer™ System		✓			**P**	
AC21-93MC30175	Portable Sensor for Hazardous Waste		✓		✓	**P**	
AC21-93MC30176	3-Dimensional Integrated Characterization and Archiving System (3D-ICAS)	24	✓		✓	**P**	
AC21-94MC31190	Coherent Laser Vision System				✓	**P**	
AR21-95MC32093	Diagnostics and Data Fusion of Robotic Sensors					**P**	
AR21-95MC32115	Multisensor Inspection and Characterization Robot for Small Pipes (MICROSPI)					**P**	

Monthly Highlights

This section summarizes some of the most significant progress achieved within the CMST area during the reporting period. More information about each project can be found on the page indicated within each summary.

- **Three-Dimensional Integrated Characterization and Archiving System (3D-ICAS)**
  The 3D-ICAS was successfully integrated with mobility platforms at Oak Ridge National Laboratory (ORNL). The system was then demonstrated at the ORNL Robotics and Process Systems Division. The demonstration consisted of mapping the wall unit (purposely contaminated with low levels of organic materials, alpha emitters, and a beta emitter), displaying the map, selecting points to be surveyed, running the contaminant survey, displaying the measured contamination in real time, and displaying detailed spatial and contamination data after the survey was completed. (Page 24)

- **Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography (ERT), and Ground Penetrating Radar (GPR)**
  The ERT and GPR prototype equipment and survey crew were deployed to Savannah River Site, where cross-hole measurements and preliminary cross-hole images were made. This field deployment at a DOE site was successful. (Page 3)

- **Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection**
  Field testing of the laser-induced breakdown spectroscopy (LIBS) penetrometer system was conducted in Albuquerque. Also, LIBS surface analysis using a prototype backpack and van-mounted system was conducted in Luckey, Ohio. (Page 1)

- **Characterization, Monitoring, and Sensor Technology Cost Savings Analysis**
  The CMST-CP began a collaborative effort in August with the Office of Science and Technology cost savings teams (i.e., U.S. Army Corps of Engineers and University of North Dakota Energy and Environmental Research Center) to document cost savings from use of innovative technologies. Ten characterization and monitoring technologies with significant cost savings potential were identified. A team consisting of a CMST-CP technical expert and members of one of the two cost savings teams conducted each cost savings analysis. Eight draft reports are complete; two technologies were determined to be ineligible for completion. The draft reports are being reviewed by individual sites for consideration of incorporating them into the 2006 Plan. Additionally, corresponding innovative technology summary reports are planned for FY 1998 publication. (Page 33)

- **Analog Site for Characterization of Fractured Rock**
  The fourth and final pulse of the infiltration test at the Box Canyon site was conducted. (Page 8)

Monthly Highlights - continued

- **Environmental Remote Sensing for Monitoring Plant Health (EPCOT)**
  The first experiment to determine the effects of light-dark cycles on fluorescence signatures in plants began in the environmentally controlled lab at The Land in the EPCOT Center. Fluorescence spectra from several crop species that have been dark adapted for hours will be compared to spectra from fully illuminated plants. In addition, the first harvest of the bean/zinc experiment was conducted. (Page 31)

- **DOE Laboratory/Industry Performance Demonstration Test**
  The first session of the project was completed in October. The Bio-Imaging Research Waste Inspection Tomography (WIT) system completed assay of four sample drums and two Performance Demonstration Program drums. The Canberra Industries Segmented Gamma Scanner (SGS) was able to complete all the test samples. The first interim report is being prepared. (Page 19)

- **Waste Inspection Tomography (WIT)**
  WIT completed the Capability Evaluation Program and Performance Demonstration Program tests at Idaho National Engineering and Environmental Laboratory for the active and passive computed tomography assay precision testing. These ongoing tests are "blind" for other systems still being tested or yet to be tested. Accuracy will be known after the public scoring disclosure from test authorities in the near future. (Page 17)

- **Associated Particle Imaging (API)**
  The final report on the Nevada Test Site field demonstration is complete. The results of the Area 5 tests on both known and unknown waste drums were encouraging. The "Lynchburg standard" drum survey showed distinct objects. The survey of the unknown drum showed a strong distributed signature of the expected material in the lower section of the drum, but no resolvable shapes. A strong oxygen signature was also detected. The conclusions are that the contents are in the form of small pieces, are distributed through the lower part of the drum, and are probably highly oxidized. (Page 26)

Subsurface Contaminants

Plumes

Field Analysis

Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection

Objective

This effort will develop a fiber-optic, laser-induced breakdown spectroscopy (LIBS) sensor and cone penetrometer system for subsurface detection and analysis of heavy metals. A rugged, small-sized, multianalyte sensor system will aid in characterizing and remediating contaminated land sites by reducing costs and analysis time.

The base phase involved the design, construction, and evaluation of fiber-optic probes and simulated penetrometer configurations to prove feasibility of the concept for analysis of soil samples. Probes were evaluated for their ability to perform quantitative analysis of Cr and Pb (or other DOE-specified elements). The option, in progress, will consist of fabricating an integrated, rugged LIBS/penetrometer system to be tested in the laboratory and at a DOE field site.

Progress

Field testing of the LIBS penetrometer system was conducted in Albuquerque. Based on these tests, improvements were made on the optics and deployment procedures. Tests showed that the sandy soil conditions in Albuquerque may be a problem for fouling, and the overall performance of the system in the field was less than expected. Because of poor results in the field, the Hanford trip was postponed so that additional testing on the probe can be accomplished.

LIBS surface analysis using a prototype backpack and van-mounted system was conducted in Luckey, Ohio. Results showed numerous areas of high beryllium contamination.

PI: Stephen Saggese, Science & Engineering Associates, (505) 884-2300

FETC COR: Karen Cohen, (412) 892-6667

Geophysical/Hydrologic Characterization

In Situ Permeability Measurements with Direct Push Techniques

Objective

This project will develop the measurement model, perform validation in the laboratory, and conduct a field test of a prototype *in situ* permeability measurement system integrated with direct push techniques such as cone penetrometers. This effort involves two major thrusts: development of a measurement model that will perform in the cone penetrometer operating environment and engineering the measurement package to satisfy the size and operational constraints of penetrometer applications.

Progress

FETC approved the subcontract with Applied Research Associates to design and build the prototype cone penetrometer permeability measurement probe; the subcontract was put in place. The data acquisition and analysis program was 90% completed, using an electronic simulator that provided signals for each of the data channels at the appropriate levels. The program will automatically acquire the pressure, temperature, and flow data and calculate the permeability in real time. Pressure histories and profiles, using the five sensors embedded in the rod, will be displayed in real time to guide the execution of the measurement. The instruments, pumps, and associated hardware were ordered. The instruments and system schematics, which will be part of the operator's manual, were developed. A revised cost plan and schedule were prepared and forwarded to FETC. Science and Engineering Associates has been in contact with Westinghouse Savannah River Co. personnel (Carol Eddy Dilek and Mike Serrato) regarding plans for the field demonstration at that site. A meeting at SRS is tentatively planned for early December. Information was provided to FETC for the Gate 4 review process.

PI: Bill Lowry, Science and Engineering Associates, (505) 424-6955

FETC COR: Karen Cohen, (412) 892-6667

Measuring Fuel Contamination Using High-Speed Gas Chromatography and Cone Penetration Techniques

Objective

This project will develop a complete system for detecting and quantifying the level of fuel contamination present in subsurface soils using cone penetrometer testing (CPT) techniques and high-speed gas chromatography (GC). A heated CPT sampling probe will be developed that will volatilize organic contaminants from the subsurface environment and convey them to the surface via heated transfer lines for high-speed GC analysis, or trap them downhole on adsorbent media for subsequent laboratory analysis.

A screening mode will be used to detect contamination. An analysis mode will be used to quantify the concentrations present. A downhole purge system for groundwater will also be developed for use with the trap or up-hole high-speed GC.

Progress

Preparation of a test plan for laboratory testing of the transfer line tubing continued. As a result of the literature review conducted during the past two months, Teflon PFA and Teflon FEP were selected for laboratory analysis to determine which tubing has less adsorption of chemical compounds for both fuel and chlorinated compounds. As an overview, the tubing will be baked out, and then three samples of a vapor mixture containing TCE, PCE, Toluene, and M-Xylene will be transferred through each of the two tubings. The concentration of the four compounds before entering and immediately exiting the tubing will be measured and compared. The decrease in the concentration at the exit of the tubing will be considered to have been adsorbed by the tubing. Based on the literature review, both tubings are expected to have less than 15% adsorbed, hopefully much less. Adsorption testing will be performed both at room temperature and at an elevated temperature. The tubings were procured and the detailed test plan will be submitted to the COR for review.

In addition to preparation of the test plan, contact was made with Steve Billits concerning the EPA Superfund Innovative Technology Evaluation (SITE) program for evaluation of groundwater samplers. As part of this contract, we are to conduct our field test as part of this program to leverage the evaluation of the probe package. The groundwater SITE evaluation is going to be run by Sandia National Laboratory and planning will begin in January. A technology selection meeting will be conducted in early January, and more details will be available then.

Finally, contact was made and a price quote was obtained from George Pappas concerning the procurement of the Electronic Sensor Technology (EST) Surface Acoustical Wave (SAW) GC unit. Although the unit is owned by the DOE, modification, certification, and training are necessary to have the unit ready for this project. The budget was readjusted to incorporate the unit for our use on this project.

PI: Wes Bratton, Applied Research Associates, (802) 763-8348

FETC COR: Steve Cooke, (304) 285-5437

Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography, and Ground Penetrating Radar

Objective

This project will develop a ground penetrating radar (GPR) cone penetrometer cross-hole measurement system for tomographic imaging and will also jointly develop an

electrical resistivity tomographic (ERT) cone penetrometer cross-hole measurement system with Lawrence Livermore National Laboratory (LLNL). These new cone penetrometer systems will be used for better subsurface site characterization and monitoring at hazardous waste sites. Integrating GPR and ERT with cost-effective cone penetrometer technology will greatly reduce the costs associated with site characterization and long-term environmental monitoring. At the end of this project, the DOE will be able to perform GPR and ERT cross-hole imaging using the cone penetrometer to install GPR antennas and ERT electrodes.

Progress

The six cone-penetrometer-installed GeoWells at the Savannah River Site (SRS) were inspected to ensure that the ERT electrodes were in place and at the correct depths to match the ERT cable bundle. The ERT and GPR prototype equipment and survey crew were deployed to SRS, and a suite of cross-hole measurements was made. Soil moisture logs were made in two of the GeoWells. Daily survey data were transmitted back to the Applied Research Associates Vermont office, and preliminary cross-hole images were available the next day. This field deployment of ERT and GPR systems at a DOE site was a success. Planning began on the second deployment at a DOE site.

The PI attended the Industry Partnership to Deploy Environmental Technology Meeting at the FETC in Morgantown, West Virginia, and presented program results.

PI: Rexford Morey, Applied Research Associates, (802) 763-8348

FETC COR: Karen Cohen, (412) 892-6667

Sensors

Measurement of Radionuclides Using Ion Chromatography and Flow-Cell Scintillation Counting with Pulse Shape Discrimination for ER/WM Applications

Objective

This effort will develop laboratory techniques for measuring radionuclides by using ion chromatography for elemental selectivity and flow-cell scintillation counting with pulse shape discrimination for isotopic selectivity. The radionuclides measurement methodology developed by this work will facilitate performance of on-line counting of both aqueous and nonaqueous samples at minimum detectable concentrations (MDCs) that are well below requirements for waste samples and are low enough for environmental screening. When coupled with off-line counting, MDCs would approach

typical regulatory limits. The project will be implemented in two parts: a base program and an option. In the base program, the contractor will focus on sample preparation and radiation detection components for developing the ion chromatography/on-line scintillation counting for environmental/waste samples.

Progress

Flow-cell scintillation detector development. A plastic flow-cell was constructed in an attempt to reduce background count rates. Characterization of five commercial cocktails was completed, and two are being evaluated for optimum sample to cocktail ratio. Ultima Flow will be modified with napthalene for further testing, as it is known to enhance pulse shape discrimination. Development of the digital dual parameter data acquisition system continued.

Development of sample processing protocols. The optimization of sample preparation protocols using element-specific resins for their efficacy in concentrating the actinides and strontium continued. A 100-mL sample from a high activity drain system at the Savannah River Technology Center was received for testing the preparation protocols with an actual sample.

PI: Angela Harrington, South Carolina Universities Research and Education Foundation, (864) 656-5569

FETC COR: Jagdish Malhotra, (304) 285-4053

Development of an On-Line, Real-Time, Alpha-Radiation Measuring Instrument for Liquid Streams

Objective

Phase 1 involved the design, development, and testing of a laboratory-scale instrument. Testing will initially be conducted using standard aqueous uranium and other low-level radioactivity solutions. Further laboratory testing will simulate field test conditions by using samples obtained from selected DOE sites. In phase 2, the phase 1 instrument will be scaled up and field tests will be performed at selected DOE sites to demonstrate the suitability of the device to detect and measure uranium and other radionuclide concentrations under field conditions. Surface, ground, and process waters will be tested.

Progress

A commercialization plan that maps out a strategy for the planned commercial introduction of the resultant instrument was submitted. Preparation of a commercial prototype analysis, design, and costing report continues. A draft field test plan was submitted and approved following minor modifications. A poster was presented at the

Industry Partnership program review held October 21 to 23 in Morgantown. The PI continues to promote interest in the technology, which has wide application across the DOE complex as well as in private industry in the areas of detection, remediation, and long-term monitoring of alpha radiation from various water sources.

A field demonstration at areas outside Oak Ridge National Laboratory will be initiated in November, pending supplemental funding.

PI: Keith Patch, Thermo Power Corp. (Tecogen Division), (617) 622-1400

FETC COR: Richard Bush, (412) 892-6426

New Environmental Measurement while Drilling

Objective

This project has demonstrated a radiation sensor and will provide additional sensing capabilities to an operational Environmental-Measurement-While-Drilling (EMWD) platform. Specific sensors for integration include a magnetometer for continuous distance and depth measurement capability as well as a heavy metal sensor.

Progress

The modified EMWD system including the magnetometer, an array of three accelerometers, and continuous distance measurement capability was assembled into one modular package and bench tested. A special stainless steel housing was fabricated to ensure proper operation of the magnetometer portion of the package. This added capability gives precise positioning information by providing pitch, roll, and azimuth. Additionally, three accelerometers provide the added capability of obtaining pitch and roll information, which is redundant to the magnetometer. However, the accelerometers will not be affected by the presence of magnetic objects (the magnetometer is affected). The EMWD system will always have the capability to give us position information no matter the environment. The integration of the continuous distance and depth measurement into the EMWD package will provide distance. The position location system will provide position in the x, y, and z directional and distance (d). The data acquisition system was redesigned to include output from the magnetometer and accelerometers so that the position data can be recorded simultaneously with the spectral data. The complete package will be field tested in November.

We are working to identify a partner site for the “Hot Site” demonstration.

We were informed that the U.S. Patent for the coaxial cable coil will be issued in early 1998. The Patent Cooperation Treaty (PCT) patent application-Chapter 1 is complete. Chapter 1 is essentially a search to determine if the invention is patentable. We

received a favorable report from the PCT examiner. We will be proceeding into PCT-Chapter 2, an examination of the patent application that results in an examination report. The report will be extremely usefully when we move into the national phase.

PI: Cecelia Williams, Sandia National Laboratory-Albuquerque, (505) 844-5722

In Situ Tritium Beta Detector

Objective

This task will design, develop, demonstrate, and deliver a monitoring system capable of detecting and quantifying tritium *in situ* in ground and surface water and in water from effluent lines prior to discharge into public waterways. This tritium beta detector will be a compact, immersible sensor; have a large wetted sensor surface area; possess high sensitivity and high specificity to 3H; have a near real-time response; be rugged; and contain integrated electronics.

In the base contract, the contractor will develop a set of target specifications and an engineering design of a system to meet those specifications. In option 1, the contractor would build the subscale prototype designed in the base contract and evaluate its performance in a set of controlled laboratory tests. In option 2, the contractor would build a final prototype and demonstrate the performance of the system at a DOE or representative test site.

Progress

The project continues behind budget and about three months behind schedule. Work under phase 1 is nearly complete, and the draft final report should be ready next month.

Sensitivity to tritium was disappointing throughout phase 1. Sensitivities of ten times the EPA safe drinking water standard have been the norm (200,000 pico-Curies/liter versus 20,000 pC/L). To verify compliance, a tritium detector must be a factor of 10 more sensitive than the standard to remain within a 5% error band, which means that the sensitivity of the McDermott monitor needs to be a factor of 100 lower.

PI: John Berthold, Babcock & Wilcox, (330) 829-7271

FETC COR: Ron Staubly, (304) 285-4991

Analog Site for Characterization of Fractured Rock

Objective

This project will develop a suite of reliable tools and methodologies that can be used for characterizing flow and contaminant transport in fractured rock. The work will focus on the Idaho National Engineering and Environmental Laboratory (INEEL) site and will include development of a conceptual model for flow and transport in the fractured basalts of the sole-source Snake River Plain Aquifer there. Of the specific technologies and methodologies being developed and investigated, many will be applicable at every contaminated site and some will have to be modified for use in a different geology.

Progress

Infiltration test at Box Canyon. In October, we conducted the fourth and final pulse of the infiltration test at the Box Canyon site, which began in September. (This test is the subject of the companion EM Science Program "Chaos" project, which is also supporting the Box Canyon field work.)

Data analysis. A master table summarizing many of the results of the FY96 ponded infiltration test is being constructed. This table will enable integration and comparison of different kinds of point measurements taken before, during, and after the test, as well as a correlation between lithology and the response to infiltration. This table is being set up as an Excel spreadsheet to facilitate manipulation such as sorting by different fields and hiding a subset of the data. It is anticipated that the table results will also serve as a template for organizing the FY97 results.

Analysis of ground-penetrating radar data indicates that subsurface radar velocities (that are a function of dielectric constant and are sensitive to moisture content) show very little response to infiltration, presumably because the initial state of the subsurface was so wet. This finding was corroborated by neutron logging and suction lysimeter data. The addition of KBr tracer to the pond water makes the pond water more electrically conductive than the native soil moisture, and should facilitate radar imaging via attenuation tomograms, as attenuation depends primarily on electrical conductivity. This analysis is in progress.

Preparation and review of journal articles summarizing the results of the project continued.

PI: Christine Doughty, Lawrence Berkeley National Laboratory, (510) 486-6453

JCCEM Contaminant Transport Studies (Pacific Northwest National Laboratory)

Objective

This project is part of a Joint Coordinating Committee for Environmental Restoration and Waste Management (JCCEM) effort on contaminant transport studies. Participants include Pacific Northwest National Laboratory (PNNL) and Westinghouse Savannah River Co. (WSRC). Program objectives include:

- establishing a mechanism for joint collaborative investigations between U.S. and Russian scientists.
- reviewing and studying data from Russian and American sites appropriate for joint coordinated activities on contaminant transport issues relevant to the needs of the DOE in developing, refining, and implementing U.S. contaminant transport models.
- publishing Russian results in English, organizing workshops to disseminate Russian information to U.S. scientists, and promoting binational cooperation.

Progress

We completed the draft FY98 joint technical work plan in preparation for the JCCEM workshop to be held November 10 to 14 in Washington, D.C., and submitted it to our Russian counterparts for comment and revision before the workshop.

We began digitizing the Mayak site characterization data received in September 1997 and converting all of our Mayak GIS coverages to be used in modeling to the Russians' Mayak plane coordinate system.

PI: Michael Foley, Pacific Northwest National Laboratory, (509) 372-4671

Landfills

Containment

Subsurface Barrier Validation with the SEAtrace™ Monitoring System

Objective

This effort will develop and demonstrate an integrated methodology and field system to evaluate the integrity of *in situ*, impermeable barriers constructed in the vadose zone. The methodology relies on the predictable process of binary diffusion of a tracer in the soil gas. A known concentration of tracer gas would be placed on one side of the barrier wall and soil gas samples would be drawn from known locations on the other side. Using inverse modeling methodology, the history of soil gas concentration at the various sampling locations allows determination of the leak location and its size.

Progress

The previous month's efforts to inject tracer gas at shallower depths were successful. The sampling ports near the engineered leaks and outside of the barrier indicated rises in tracer gas concentrations. Because the background tracer concentrations were non-zero (from the previous tests) the data had to be manipulated to remove the effects of the background. Data inversion for leak location was accomplished on a desktop computer. The control computer in the monitoring system was performing leak location calculations automatically, but was unable to locate leaks accurately because of the excessive background concentrations.

The PI attended the Dover Air Force Base open house of technology demonstrations at the Groundwater Remediation Field Laboratory (GRFL) on October 23 and 24. Information on the SEAtrace™ barrier verification test results was presented to Air Force, DOE, and private sector participants.

PI: Bill Lowry, Science and Engineering Associates, (505) 424-6955

FETC COR: Karen Cohen, (412) 892-6667

Post-Closure Monitoring

Development of a Long-Term, Post-Closure Radiation Monitor

Objective

This project is designed to develop a low-cost, multi-point radiation monitoring system for long-term, continuous monitoring of radiation levels in the vadose zone of

hazardous waste sites. Based on gamma spectroscopy, the system will be able to monitor to depths of more than 50 meters without the necessity of drilling wells. The system will be capable of nearly unlimited numbers of completely passive, permanently installed probes. None of its electronic components will be belowground, and a single, aboveground opto-electronics unit will be capable of multiplexing a large number of independent probes via optical fibers. This combination will form a system not commercially available now. In phase 1, Babcock and Wilcox (B&W) configured a system from commercial components that could monitor radionuclides in soil to pCi/g levels. The project is in phase 2.

Progress

Oxford personnel visited again and helped Mechanical Technology, Inc., identify system bugs; fixes are being implemented. They are also supporting optimization of the nuclide libraries. Additional checks are being performed to better define system temperature sensitivity.

PI: Stuart Reed, Babcock & Wilcox, (330) 829-7350

FETC COR: Jagdish Malhotra, (304) 285-4053

Current Practice

Current Practice of Environmental Characterization and Monitoring Technologies

Objective

This project will document current practices of environmental technologies in the areas of site characterization and waste/processing monitoring. This activity will (1) collect, assess, and compile information from technology users and purchasers in DOE and EPA environmental management programs and (2) produce a database for technology users, purchasers, and project sponsors. The interactive database will be published on the Internet. Additional technologies used in other federal programs (i.e., the DoD, DoC, and DoI) as well as at private company sites will be included in the out-years.

Progress

Discussions are being held with a web database developer and a database developer/marketer to plan a collaborative effort with technology users within the DOE and to further develop the overall design of the project and its measures of success. The executive summary of the draft report, “Survey of Current Practice of Environmental and Monitoring Techniques at Selected DOE Sites,” is being edited.

PI: Stephan Weeks, Special Technologies Laboratory, (805) 681-2262

High-Level Waste Tanks

Safe Storage

Robotic End Effector for Inspection of Storage Tanks

Objective

This effort will develop and demonstrate a robotic tank inspection end effector (RTIEE) capable of both visual and nondestructive evaluation (NDE) of the interior walls of stainless steel and carbon steel waste storage tanks. It will detect and size corrosion damage caused by surface pitting in stainless steel and carbon steel tank walls. This system will be based on an alternating current field measurement (ACFM) technology that provides remote operator video data and indicates wall corrosion. The inspection robot operator will be presented with a graphical ACFM appraisal of the condition of the scan area on the video monitor.

In phase 1, the contractor defined end effector system requirements to include designing, fabricating, assembling, and testing the pre-prototype system at a robotic lab configured to simulate representative manipulators. Software development work is compatible with the Generic Intelligent System Control (GISC).

Progress

Stationary scans were performed using the radiation-hardened RTIEE scanner frame assembly. Test results indicate the new array's output is consistent with the tank-ready prototype. The array is being tested using machined slots, calibrated fatigue cracks, and pits in the Carbon and stainless steel sample plates. The updated array transport cable and limit switch components functioned perfectly. The printed circuit card design was completed for the revised at-tank electronics needed to support the camera and upgraded short circuit protection. Oceaneering Space Systems (OSS) received the tool interface plate from Idaho National Engineering and Environmental Laboratory (INEEL) and measured the hardware to design the mating part, the modified back plate of the RTIEE.

Three standoff sensors will be incorporated into the RTIEE scanner frame to provide the flyby detection threshold and the precision standoff data needed for crack depth sizing during stationary scanning.

OSS continued discussions with Savannah River Site (SRS) personnel regarding the clean up of annulus waste in preparation for NDE inspection. OSS and Hanford met with Westinghouse and DOE personnel at SRS on October 9 at the site to discuss the Tank 16 application. OSS initiated development of the equipment needed to retrieve several samples of the salt cake from the annulus to enable the full characterization of

the waste. A meeting to support the delivery of the sampling system is scheduled for the first week of December.

PI: Tom Gaseor, Oceaneering Space Systems, (713) 488-9080 ext. 3208

FETC COR: Maria Vargas, (304) 285-4617

Waste Retrieval

Electrical Resistance Tomography for Subsurface Imaging

Objective

We are using electrical resistance tomography (ERT) to map changes in formation water content caused by the subsurface processes of electrokinetic remediation and leaks from waste storage tanks. This project has three technology development tasks. The first is development, demonstration, and technology transfer of ERT for monitoring leaking tanks. If successful, it will go to a full-scale demonstration on an underground storage tank (UST) during sluicing operations with UST Focus Group sponsorship. The second task is to extend the data processing algorithms to fully three dimensions. The third task is to finish reduction, analysis, and reporting on the detection of dense nonaqueous phase liquids (DNAPLs) and to clean up DNAPL-contaminated soil from the test soil tank at the Oregon Graduate Institute (OGI) Large Experimental Aquifer Program (LEAP) tank facility. Lawrence Livermore National Laboratory (LLNL) will coordinate all tasks.

Progress

The project is on schedule. A journal paper is being prepared.

PI: Bill Daily, Lawrence Livermore National Laboratory, (510) 422-8623

Sensor for Viscosity and Shear Strength Measurement

Objective

This continuation of work begun in FY96 will focus on developing a small, nonmechanical sensor for measurement of viscosity and shear strength of tank waste slurries. FY96 work included a review of current and emerging technologies used to measure the rheological properties of materials for determining fluid viscosity. Two approaches to sensor design were developed—a torsional wave sensor, based on a

torsional wave transmission in a rod immersed in a fluid, and an oscillating cylinder viscometer, based on a vibrating cylinder. FY97 work included the fabrication, evaluation, and test insertion of each sensor at Oak Ridge National Laboratory (ORNL).

Progress

Acoustic method. Limitations in the acoustic apparatus include the following: (a) there is instability in the rod magnetics; (b) the transducers generate both torsional and longitudinal waves, which clutter the wave forms; (c) there is instability in the Panametrics Pulser: sometimes it would put out no pulse at all, then later it would start up correctly; (d) there is insufficient acoustic isolation between the two rods and between each transducer or rod and the supporting structure. The supporting structure tends to dampen the wave, reducing its amplitudes. Also, no temperature controller was used to maintain a constant container liquid temperature. Because of funding limitations, the debugging of the acoustic *LabView* software was not completed.

Despite these limitations, valid data and wave forms were taken manually using the Tektronix storage oscilloscope. This oscilloscope directly drove our printer to give full-page plots of wave forms. However, the *LabView* GPIB software programming was not written so that the wave forms it displays can be transferred as data into the lab computer. When such programs are developed, the wave forms can be inserted directly into any report file.

This month, data were read directly from the wave forms and recorded manually. A FORTRAN program was written and used to calculate viscosity from these time data. When measuring glycerin over a wide temperature range, the calculated results agreed with published data with good accuracy. At room temperature, water mixed with sugar, sand, clay, and gravel could also be measured properly for particle sizes of less than one millimeter, and results agreed with published data. However, for a reason not yet discovered, the calculated viscosities of such mixtures at higher temperatures do not appear to follow published data.

Oscillating cylinder project. The new, wall-mounted, three-phase, five-wire power outlet easily drives the switch, motor controller, and motor. As per its design, a noise filter was connected inside the switch box between the three-phase source and the 120-V power strip on the same panel with the switch and controller. The filter was intended to attenuate the conducted switch pulses (noise) generated by the controller. However, noise reaches the power strip either by radiation or because of insufficient filter attenuation of conducted noise. Hence, the displacement signal conditioner's power supply cannot yet be plugged into the panel's power strip. Readings were taken by plugging it in at a distance. A permanent solution requires more investigation.

Some *LabView* programming was attempted for the oscillating cylinder instrumentation, but insufficient time and resources were available to complete the work. Displacement

(but not force) data were acquired by the computer using a *LabView* program and the National Instruments Data Acquisition board (not the GPIB). The Tektronix storage oscilloscope cannot be used satisfactorily to process displacement and force wave forms because of voltage limitations and a low (50 ohm) input impedance.

A Hewlett-Packard 500 MHz storage oscilloscope was used with a 1 Mega-ohm input impedance. There is substantial noise in the force wave forms. If this project is continued, these wave forms could be cleaned up in *LabView* using time ensemble averaging. To reduce this noise on the force wave forms, time ensemble averaging was implemented by means of the storage scope. Wave forms were acquired using a camera, and the pictures will be inserted into the annual report. Several different programming alternatives were investigated whereby wave-form data could be transferred directly from the scope into the lab computer over a GPIB bus.

This is the final monthly progress report for this project; we expect to write the final report outlining the accomplishment of the past two years next month.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

Ultrasonic Sensors for *In Situ* Monitoring of Physical Properties

Objective

This project will develop ultrasonic sensors for *in situ* monitoring of physical properties of radioactive tank waste. The initial focus is on developing sensors for fluid viscosity and volume-percent of solids measurements. The sensors will apply mainly to waste transport lines for on-line characterization. The task is to examine the feasibility of measuring fluid shear impedance to determine viscosity and measuring scattering cross-sections of ultrasonic waves to determine solid concentration. The feasibility of the impedance technique is on the issue of low-viscosity (<30 cP) measurement because the technique has been well demonstrated in the high-viscosity (>1,000 cP) range. The concept of determining solid concentration from scattering cross-section measurement is a new approach and requires a thorough study.

Progress

We continue to develop a more reliable ultrasonic technique for measuring solid concentration. Laboratory tests to determine sound velocity and attenuation are conducted for solid/liquid slurries with mixed solids, sand, and kaolin.

The FY97 annual report is being prepared.

PI: Shuh-Haw Sheen, Argonne National Laboratory, (630) 252-7502

Process Monitoring

Development of Process Monitors for Cesium-137 Column Breakthrough

Objective

This project will optimize an inexpensive, highly reliable, near real-time monitoring system for the specific detection of ^{137}Cs in the effluent from an ion exchange column. A matched pair of radiation detectors will be used to monitor activity in the effluent stream at two locations separated by a short span of time.

Progress

A visit to Oak Ridge National Laboratory (ORNL) provided the groundwork for transferring the technology to ORNL for a demonstration. Subsequently, a meeting was held among the principals from Idaho National Engineering and Environmental Laboratory, ORNL, and Pacific Northwest National Laboratory to define the technical requirements for the first demonstration project. The use of NaI(Tl) spectrometers was deemed adequate and most appropriate for this demonstration, and a preliminary physical design was selected. Subsequent discussions with ORNL staff produced a more detailed design configuration, and plans are in place to finalize the detailed design. Sufficient information was obtained to define the hardware required for data acquisition/reduction, and purchase orders for the detectors and electronic components are being prepared. Engineering drawings are in progress. Software development for data acquisition/reduction continues. Materials for the Focus Area project level review were prepared and forwarded to Ames Laboratory. A paper describing the current state of the technology development was presented at the 37th ORNL-DOE Conference on Analytical Chemistry in Energy Technology.

PI: Ron Brodzinski, Pacific Northwest National Laboratory, (509) 376-3529

Mixed Wastes

Pre-Processing Characterization/Monitoring

Waste Inspection Tomography

Objective

This project will construct a transportable inspection system to characterize containers of radioactive waste by nondestructive evaluation and assay. The Waste Inspection Tomography (WIT) system is contained in a semitrailer that could be driven to various DOE sites. Containers of waste at these sites would be imaged and the radioactive components analyzed without opening or physically sampling the containers. The purpose of the system is to allow rapid, cost-effective reduction of the backlog of radioactive waste containers by characterizing them as safe for storage at approved underground sites, or else by determining if additional treatment is required before such storage. The development effort will involve integration of two forms of computed tomography, transmission and emission.

Progress

WIT completed the Capability Evaluation Program (CEP) and Performance Demonstration Program (PDP) tests in October at Idaho National Engineering and Environmental Laboratory (INEEL) for the active and passive computed tomography (A&PCT) assay precision testing.

An eighth replicate was taken, but it was discarded because the HPGe detector was warming up during data collection. A liquid nitrogen refill took place during this eighth replicate measurement. All other (7) replicates clustered around a 3.3% assay uncertainty while this single (eighth) replicate was 50% larger. Assay uncertainty is defined by the percentage of the standard deviation divided by the mean of the replicated ^{239}Pu direct measurement. Total uncertainty is the root mean squared of an estimated 5% systematic error and the assay uncertainty (as stated above); it does not take into consideration algorithm accuracy bias.

The results are representative of the WIT A&PCT precision and do not reveal accuracy because these ongoing tests (CEP and PDP) are blind for other systems yet to be tested or those that are still being tested. The WIT assay (counting) uncertainty is typically between 1% and 5%, while our estimated total uncertainty is between 5% and 7% (excluding bias). These tests are encouraging in that the precision based on matrix is reasonable for WIT A&PCT. Accuracy will only be known with public scoring disclosure from the test authorities in the near future. The Rapid Commercialization Initiative (RCI) WIT testing, which occurred last winter at INEEL, was missing the replicate precision data. The results are significant because the RCI test data can now be validated by using the precision data for WIT A&PCT nondestructive assay.

Additionally, the PI presented a paper at the annual FETC conference in Morgantown, West Virginia, summarizing WIT activities in 1997 including RCI, CEP, and PDP nondestructive testing as well as WIT nondestructive examination activities at INEEL.

PI: Richard Bernardi, Bio-Imaging Research, (847) 634-6425

FETC COR: Steve Cooke, (304) 285-5437

Nondestructive Examination and Assay of Drums Containing Transuranic Waste

Objective

This project will develop and integrate techniques for nondestructive examination and assay of drums containing transuranic (TRU) waste. The data output from the integrated system, consisting of X-ray, gamma-ray, and neutron interrogation methods, will be combined using computer data fusion techniques. The X-ray and gamma-ray inspection modalities are provided by the Waste Inspection Tomography (WIT) system developed under a separate DOE contract; neutron inspection will be provided by the Active Passive Neutron Examination Assay (APNEA) system, developed by Lockheed Martin Specialty Components. The integrated system will provide identification of the waste matrix and its density distribution; location of gamma emitters and fissionable components; identification of isotopes; TRU waste localization; and total TRU waste quantification. An imaging computer interface will be developed for data fusion and presentation in a manner consistent with the Waste Isolation Pilot Plant Waste Acceptance Criteria and the Quality Assurance Program Plan.

Progress

In late October, the APNEA team presented a draft report on the seven common Rapid Commercialization Initiative (RCI) drums assayed by both APNEA and WIT. This report was prepared by Dr. Dick Bramblett, senior physicist supported by TRUtech under the management of that company's president, Mr. Gerry Streier. The remaining 200+ RCI drum assay data from APNEA will be presented early in November. Bio-Imaging Research (BIR) will evaluate the seven common RCI drums and compare the results with WIT in December. With the presentation of the data from the APNEA group, this contract can now move onto completion with the full intent of completing all objectives including the data fusion of WIT and APNEA results. BIR personnel will work on neutron and gamma assay data fusion in December. Additionally, the data can be used to complete the RCI project by providing for three verification statements (APNEA stand-alone, WIT stand-alone, and joint WIT-APNEA).

PI: Donald Robertson, Bio-Imaging Research, (847) 634-6425

FETC COR: Steve Cooke, (304) 285-5437

DOE Laboratory/Industry Performance Demonstration Test

Objective

To facilitate the characterization of waste drums at DOE sites and to determine if additional nondestructive evaluation/nondestructive assay (NDE/NDA) technical development is needed, it will be necessary to establish the performance capabilities of the NDE/NDA technologies that will make those characterization measurements.

To accomplish this objective, a series of performance demonstration measurements will be conducted at Idaho National Engineering and Environmental Laboratory (INEEL) with selected participating technology holders. The results will be used to prepare two reports, one for EM-30 to use for equipment selection decisions and the other for EM-50 to determine the amount, if any, of additional development efforts to fund.

Progress

The first session of the project was completed in October. The Bio-Imaging Research Waste Inspection Tomography (WIT) system and the Canberra Industries Segmented Gamma Scanner (SGS) were removed from the test facility in late October. WIT completed assay of four sample drums and two Performance Demonstration Program (PDP) drums during the period that it was permitted to perform these functions. SGS was able to complete all the test samples and perform analysis during its stay at INEEL. Activities were initiated to begin the next session of the evaluation. The systems will be supplied by Canberra Industries: the high efficiency neutron counter (HENC) and the IQ3 gamma system. Site visits were made to physically walk down each mobile system, and a safety analysis for each system was prepared. The safety analysis must be approved before moving the mobile systems into the test area.

The first interim report is being prepared. Vendor data must be reviewed, scored relative to exact values within the surrogate drums and prior measurements on the actual waste samples. Following scoring, the results on the surrogates and certain characterized samples will be reported to the vendors in terms of whether their results fell within the limits defined by the Waste Isolation Pilot Plant Quality Assurance Performance Plan, Table 9-1. Following completion of all testing, vendors will be notified of known values for each sample and surrogate and respective scoring for each measurement.

Activities are in progress to develop support for a third session of the evaluation. Potential participants were identified, and efforts are focusing on developing the funding needed to support the activity. In addition, the Stored Waste Evaluation Pilot Plant (SWEPP) has requested to participate in the evaluation. Funding is also being developed to support this additional participant.

PI: Mike McIlwain, Idaho National Engineering and Environmental Laboratory, (208) 526-8130

Intelligent Inspection and Survey Robot

Objective

This project will develop and demonstrate a semi-autonomous vehicle to inspect drums or other containers stacked in rows in central storage facilities. The Autonomous Robotic Inspection Experimental System (ARIES) will autonomously enter and trace an inspection route while actively avoiding obstacles. A camera vision system will be used to assist in the inspection of drums and other containers. The vehicle will be designed to meet the operating environment constraints associated with typical mixed waste storage facilities.

In phase 1, the ability of a testbed robot subsystem to navigate and observe visual damage in a simulated drum storage area was developed and tested. Phase 2 involved integrating subsystems into a robot that can inspect drums while navigating through 36-inch-wide aisles. Phase 3, in progress, involves demonstrating a refined commercial unit at one or more drum storage facilities.

Progress

The system was operated to test the performance of all the components at a Cybermotion facility test site. Final integration of the Mission handler and vision code was completed. A two-day orientation was provided for the Los Alamos National Laboratory (LANL) project manager at Cybermotion. New fiducials (calibration target points placed about an area to orient the robot) were designed and constructed for the Laser Infrared Direction and Ranging (LIDAR) system. The crating was constructed and preparations were completed to transport the system to LANL in early November for testing and long-term operation.

Changes to the code will be updated to meet the site-specific requirements and expectations. A potential concern is the bar-code reader's performance. There are indications that the unit requires laser-printed bar-codes, and that there will be definite (minimum) size constraints on bar-codes. Also, issues concerning proper calibration of the color camera need to be resolved.

PI: Robert Pettus, South Carolina Universities Research and Education Foundation, (864) 777-9569

METC COR: Vijendra Kothari, (304) 285-4579

Automated Baseline Change Detection

Objective

This work will complement current DOE projects by developing a reliable, accurate automated baseline change detection (ABCD) system that applies recent advances in optical sensor positioning technology to automatically detect and isolate barrel changes that may indicate potential containment failures. Regulations require weekly

inspections of the thousands of barrels containing mixed waste stored at DOE sites. Manual inspection processes are time consuming and of inconsistent quality, and they expose humans to toxic and radioactive materials. Phase 1 will involve a laboratory demonstration and delivery of the deployable prototype robotic mobile sensor system for the automated inspection of warehoused barrels containing mixed waste. The phase 2 mobile field system is expected to integrate the baseline-change detection sensor with an autonomous mobile platform in a manner that satisfies DOE requirements.

Progress

This contract was extended until November 30. FETC is expecting a draft final report.

PI: Eric Byler, Lockheed Martin, (415) 424-2380

FETC COR: Vijendra Kothari, (304) 285-4579

Waste Process Monitoring and Controls

Real-Time Plutonium Monitoring

Objective

Transient infrared spectroscopy (TIRS) is a nondestructive, nonintrusive technique that uses infrared spectroscopy to chemically analyze moving process streams. Preliminary experiments have shown that plutonium (Pu) and samarium (Sm) in glass have distinctive spectral features in the near-infrared range that could be used for real-time TIRS monitoring of their concentrations in a glass stream. Savannah River has endorsed production of a TIRS monitor capable of real-time monitoring of Pu and Sm concentrations and other important parameters of a molten glass stream, and the transfer of this technology to the Savannah River Site (SRS) and other sites is the ultimate goal of this project.

Progress

In October, we began working with a new end user group at Savannah River, the Am-Cm Stabilization Project. We are determining the details of their on-line analysis need; in general, their needs are sufficiently similar to those of the previous end user so that only modest changes in the equipment and procedures will be needed to accommodate them. Through a literature search, we determined that the spectroscopy of americium in glass is similar enough to that of plutonium in glass that no changes in the equipment will be needed to monitor americium instead of plutonium.

PI: John McClelland, Ames Laboratory, (515) 294-7948

Offgas and Effluent Monitoring

Development of a Multielement Metal Continuous Emissions Monitor

Objective

This project will combine the air - inductively coupled plasma (ICP) atomic emission continuous emissions monitor (CEM) being developed at Diagnostic Instrumentation and Analysis Laboratory (DIAL), Mississippi State University (MSU), with the High Resolution Interferometric Spectrometer (HiRIS) being developed by Ames Laboratory. The HiRIS was developed for monitoring the isotopic composition of actinides, providing the resolution and sensitivity of a 1.5-meter spectrometer in a much smaller, lighter, and cheaper device. This project will (a) assemble a version of this device, incorporating components for ultraviolet operation, for detection of EPA-regulated metals, (b) integrate it into the DIAL CEM, and (c) demonstrate the system, with the DIAL developer, at a test facility. The HiRIS is completely electronically tunable and will be equipped with extensive software control and analysis routines to enable sensitive and accurate calibration and continuous monitoring.

Progress

Our portion of the report of the results from the test at the EPA facility in September was completed and sent to Dr. Miller at DIAL for inclusion in the report on the air-ICP system. We are continuing to evaluate statistical comparisons with the reference method data.

We have begun work on an array-based spectrometer. We began examining available charge coupled device systems and how they will meet our needs. Meanwhile, we are using an existing photodiode array (PDA) to perform bench tests for optical design. The PDA will not provide sufficient sensitivity for the final instrument.

The delayed release of the full funding for FY98 will delay acquisition of components for the next generation HiRIS. It is unlikely that a two-month delay would significantly impact milestones later this fiscal year, but a three-month delay could.

PI: David Baldwin, Ames Laboratory, (515) 294-4748, dbaldwin@ameslab.gov

Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment

Objective

This task will develop and demonstrate an instrument using laser-spark-emission spectroscopy (LASS) as a continuous monitor to measure metal emissions from offgas of thermal treatment units. The project will address several important issues for the instrument, including sensitivity (at ppb concentrations for metals governed under the

clean air act), calibration, durability, reliability, and accuracy. The purpose of this development is to design, build, and test a field instrument at a DOE facility.

Progress

Data analysis was started for the two field tests. The Reference Method data for the two tests were received recently and will allow quantitative assessment of the monitor performance. Between the EPA and Toxic Substances Control Act (TSCA) tests, 38 individual 1- to 1.5-hour reference method tests were conducted, with the laser-induced breakdown spectroscopy (LIBS) system being on-line 100% of the time. Full reports of both field tests were initiated.

Hardware modifications were completed during October. Specifically, a new probe extension was designed, fabricated, and installed on the monitor. The new probe extension, or snout, has an outside diameter of 2.5 inches and an overall length of 24 inches. The new probe is compatible with both 3- and 4-inch NPT pipe or ANSI flanges.

PI: David Hahn, Sandia National Laboratories, (510) 294-3337, dwhahn@sandia.gov

Disposition of Facilities (D&D)

Surfaces

Three-Dimensional Integrated Characterization and Archiving System

Objective

This project will develop an integrated system that remotely characterizes, maps, and archives measurement data of hazardous decontamination and decommissioning (D&D) areas. The system will generate a detailed 3D topography of the area as well as real-time quantitative measurements of volatile organics and radionuclides. The system will analyze substrate materials consisting of concrete, asbestos, and transite, and will permanently archive data measurements for regulatory and data integrity documentation.

The objectives will be completed in three phases. In phase 1, Coleman Research Corp. demonstrated the Coherent Laser Radar (CLR) mapping capabilities (0.5 mm resolution over a 15 m range) in the laboratory, along with the ability of the high-speed gas chromatograph (GC) to resolve more than 200 peaks in less than 30 seconds. In phase 2, Coleman developed, integrated, and demonstrated the subsystem components to form the 3D Characterization and Archiving System (3D-ICAS). In phase 3, the objective of this effort is to integrate all the subcomponents and demonstrate the capability of the system at the Oak Ridge National Laboratory (ORNL) site, as well as to demonstrate a fully integrated 3D-ICAS at Maturity Level V.

Progress

The integrated 3D-ICAS was successfully integrated with mobility platforms at Oak Ridge National Laboratory (ORNL). The Coherent Laser Radar Mapper was operated on the OmniMate robotic platform, and the contaminant analysis units and robot arm carrying the multisensor probe head were integrated on the overhead transporter.

The system was subsequently demonstrated at the ORNL Robotics and Process Systems Division on October 29. The demonstration was conducted in the hi-bay area using a wall unit constructed for the demonstration. The unit consisted of pieces of cement-based wallboard and a small piece of an asbestos-containing material (ACM). The unit was purposely contaminated with low levels of organic materials, alpha emitters, and a beta emitter.

The demonstration consisted of mapping the wall unit, displaying the map, selecting points to be surveyed, running the contaminant survey (which required moving the sensor/analysis unit with the transporter and acquiring the sensor unit with the

3D-mapper), displaying the measured contamination in real time, and displaying detailed spatial and contamination data after the survey was completed.

An unfortunate hardware failure the day before the demonstration prohibited acquisition of contaminant data from the high-speed gas chromatograph (HSGC)/mass spectrometer (MS), and only the Molecular Vibrational Spectrometer (MVS) provided real-time identification of the substrate material during the demonstration. This was a significant success because the MVS correctly identified the wallboard as being cement, even though the particular substrate sample had not been included in the system's neural network training set. Failure of the HSGC/MS was unfortunate, but its performance was well documented and demonstrated before the demonstration at ORNL. The failure did not detract from the main objective of the demonstration, which was to show end-to-end system operation with the 3D-ICAS mounted on ORNL mobility platforms.

PI: Ray Ross, Coleman Research Corporation, (703) 719-9200

FETC COR: Vijendra P. Kothari, (304) 285-4579

Metals and Pipes

Portable X-Ray, K-Edge Heavy Metal Detector

Objective

This work will develop improved nondestructive assay (NDA) techniques for detecting and quantifying uranium, plutonium, and other heavy metals. The work will focus on situations where these elements are located inside sealed containers or processing equipment. The approach to this problem is based on observing the K-edge absorption transition in X-ray transmission measurements. The technique will be developed to maximize sensitivity for detecting heavy metals, while minimizing measurement time.

Progress

In FY97, two field demonstrations of this system occurred. At the Oak Ridge K-25 Site, a series of one-inch ID pipes containing uranium deposits was inspected using the X-ray imaging and K-edge quantification techniques. Concentration levels ranging from 10 mg/cm^2 to 6,000 mg/cm^2 were measured and found to be in agreement with results from NDA measurements. In a demonstration at the Iowa State University Nuclear Engineering Laboratory, the K-edge method was used to measure uranium concentration in stacks of reactor fuel plates. Concentrations ranging from 50 mg/cm^2 to 3,000 mg/cm^2 for different numbers of plates were found to be in good agreement

with the manufacturer's specifications. It was further demonstrated that the K-edge detector can operate in a high radiation environment (> 200 mR/hr).

Analysis of the data from the tests on the uranium fuel plates is nearly complete, and a report on these results is being written. Results from this second test have implications for possible applications at Idaho National Engineering and Environmental Laboratory (INEEL) and Westinghouse Savannah River Co. (WSRC). In both cases, characteristics of spent nuclear fuel must be verified for storage of the fuel. K-edge analysis could provide accurate nondestructive measurements of the total uranium content in the fuel, which would be useful in determining other characteristics such as enrichment. Previously, C. L. Bendixsen of INEEL was contacted; this month, contacts were made with Allen Brewer and Trent Andes of WSRC.

On October 21, the PIs met with Mike Brisson and Vernon Jones of WSRC and demonstrated the K-edge detector. The 94-1 Analytical program at SRS has a need for characterizing legacy Pu-bearing materials. The K-edge technique may be applicable at some stages during the processing of this material.

PI: Joe Gray and Terry Jensen, Ames Laboratory, (515) 294-9745

Associated Particle Imaging

Objective

The Associated Particle Imaging (API) field system will address the radioactive contamination need for active radiological measurements of embedded contaminants. API is a means of characterizing the elemental composition of materials and their shapes in three dimensions even when buried within other structures and accessible for interrogation from only one side.

The project will measure and characterize a customer-defined contaminant deposit at the K25 site in Oak Ridge, Tennessee, using the API system. The mobile API system will be prepared at Special Technologies Laboratory (STL), including procurement, testing, and system integration of a new sealed tube neutron generator (STNG) tube. With support from K25 personnel, the API system will be demonstrated at a location of their choice. Appropriate industry representatives will be invited to the demonstration to introduce the API technology to the commercial sector. The priority target will be observed and applicable data provided to K25 personnel in a summary report.

Progress

The final report on the Nevada Test Site (NTS) field demonstration is complete except for inclusion of the color figures and distribution of the report.

The Area 25 tests on piping inside a building were inconclusive. We observed a strong ^{137}Cs signature in the area, but were unable to resolve any solid or liquid matter in the pipe sections we surveyed. Our conclusion is that the ^{137}Cs is distributed throughout the pipe system in low concentration, with no large mass buildup.

On the other hand, the results of the Area 5 tests on both known and unknown waste drums were very encouraging. The "Lynchburg standard" drum survey showed distinct objects. These results still need to be compared to the map of the contents, which we will soon receive from our contact at NTS. The survey of the unknown drum was a true "blind test" because not even NTS personnel knew its contents. Our survey of it showed a strong distributed signature of the expected material in the lower section of the drum, but no resolvable shapes. We also detected a strong oxygen signature. Our conclusions are that the contents are in the form of small pieces, are distributed through the lower part of the drum, and are probably highly oxidized.

PI: Chuck Hudson, Special Technologies Laboratory, (805) 681-2248

Facility Characterization

Airborne and Ground-Based Laser-Induced Fluorescence

Objective

This project will further develop and test the capability of laser-induced fluorescence imaging (LIFI) techniques for detection of uranium, heavy metals, organic compounds, and vegetation stress. The project's major efforts are: (1) to develop an airborne LIF system for survey of large geographic areas, and (2) to develop a handheld LIF instrument for detection of uranium on surfaces during decontamination and decommissioning (D&D) operations. Specific tasks include: (1) handheld uranium survey tool development, (2) support for the Cooperative Research and Development Agreement (CRADA) with Disney/EPCOT Center, and (3) airborne LIF tests and evaluation.

Progress

We made significant progress on the LIFI backpack system. A preliminary design of the laser system was received from BigSky, and several design reviews resulted in rendered drawings of the final system. These drawings reflect the use of a new laser power supply configuration that is compatible with a backpack. The frame grabber/computer system was assembled as a brass board and tested, and images were collected from video.

Modifications were made on the LIFI SPOTLIGHT system, including (1) some software changes to allow averaging of images over several laser shots and
(2) hardware changes that allow storage of these data files. This system will serve as a backup for any future parallel efforts, such as the FBI memorandum of understanding signing that was postponed indefinitely from September.

The airborne LIFI team returned from Ft. Rucker and began analyzing the data in October. During the Ft. Rucker flight tests, a target field had been constructed by laying various fabrics in a pattern on a runway at a controlled site near Ft. Rucker. On the overflights, the waterfall display in the helicopter had indicated that numerous targets were observable, and our preliminary analysis of imagery data confirmed that targets were observed and recorded.

For further analysis, the data were converted back to 12-bit integer files and viewed as 128-channel spectral data in an image-processing package (ENVI). Whereas the data were recorded as 128 channels, the limiting resolution was determined by the slit width, which was operated wider during these tests. This reduced the limiting resolution to closer to 20-25 nanometers.

The emission yields of the fabrics spanned more than a factor of 100 with the brightest fabrics near 10% and the weakest fabrics with emission characteristics that were less than the surrounding grass areas. The imagery shows that while most of the fabrics were detectable, the weakest fabrics and the grassy areas did not have enough photons/pixel to recover a complete spectrum at each resolution element.

After subtraction of the charge coupled device (CCD) camera dark noise, only a few counts of electronic noise per pixel were found (perhaps due to noise from the laser and helicopter). This is viewed in a highly stretched image file as a weak herring-bone pattern. Single photons were recorded as spots on the imager that were well above the CCD noise floor. This means that the limit in system sensitivity lies before the microchannel plate and therefore can be improved. The data analysis indicates that there needs to be a significant increase in sensitivity before the system is flown over weaker signatures such as green vegetation and aquatic environments.

We believe that there are several compounding reasons that we are seeing less photons/pixel on the standard targets than we expected based on radiometric models. While several factors are probably contributing, it is likely that the concave holographic grating has aged and that this is causing a loss of throughput in the spectrometer. Discussions with the manufacturer have reinforced this thinking.

We are engaging in preliminary discussions with personnel at the Savannah River Site (SRS) with the objective of performing data flights at several locations there early next spring. SRS is an ideal choice because of the possibility of detecting surface uranium, as well as the measurement of plant stress signatures due to subsurface contamination, which fits in perfectly with our current work at EPCOT Center. Additionally, LIFI

was cited in the SRS FY98 Linkage Table as being an applicable technology for their site characterization needs.

Based on the analysis, several corrections need to be made before the next flight. These include:

- increasing the sensitivity by correcting problems in the spectrometer and adjusting the width of the illumination spot to better match the camera field-of-view (FOV); a decreased width of 20% may be accomplished with a lens replacement
- adjusting the camera readout versus the MCP shutter time (this software switch was identified and corrected)
- modifying the terrain following software (a software glitch was identified and corrected).

The camera, camera controller, and computer system will be returned to Santa Barbara in late November by a Special Technologies Laboratory (STL) team. Increased sensitivity will be addressed in January when the camera will be inspected in depth. The grating will be recoated by the manufacturer if it is found that the reflectivity has greatly diminished. The grating repair and adjustment of the laser spot size should increase the sensitivity to the level required for the proposed measurements at Savannah River.

The remaining components of the LIFI system will be unloaded from the helicopter at Ft. Rucker so that the system can be used on other projects. The STL hardware will be stored at Ft. Rucker until the spring "leaf out." If all issues are resolved, the system will then be reloaded (about 1.5 days of work) and flown at the Savannah River Site.

PI: John DiBenedetto, Special Technologies Laboratory, (805) 681-2240

Laser-Induced Fluorescence for Heavy Metals in Soils and Plants

Objective

This task will conduct a demonstration of the laser-induced fluorescence imaging (LIFI) technology for the detection of heavy metals in soils and plants in Poland. The handheld LIFI unit will be used to collect data from vegetation of interest within the test study area, as well as from experimental plots to be supplied by the Institute for Ecology of Industrial Areas (IETU) in Poland. The portable survey tool will be prepared (i.e., modified, assembled, and tested) for use in Poland. The Special Technologies Laboratory (STL) team will travel to Poland to take plant fluorescence data in various spectral bands at a chosen field site, and return to STL to analyze the collected data.

Progress

We have approximately $12 K of carryover funding available for wrapping up this task and writing the final report.

After the successful data take in Poland in September, in cooperation with the Institute for the Ecology of Industrialized Areas (IETU), Poland, Phytotech (USA), and others, the portable LIFI/laser-induced fluorescence spectroscopy (LIFS) system arrived back in our laboratory this month. Some pieces of equipment, notably the Princeton Instruments camera and the Dolch computer, were sent to the manufacturers for repair. The camera had developed several problems that interfered with optimum performance, including failure to properly cool, intermittent high-voltage system failure, and noise spikes in the charge coupled device (CCD) output; the computer had an intermittent problem with the power switch.

The data take on brachinia (the plant species chosen by IETU for study in the field, and a cross between rape and cabbage) was a success. About three-quarters of the 100+ spectral data files (LIFS) were examined, but characteristics of the spectra are not yet tabulated. We are also beginning to examine the fluorescence images (LIFI). IETU is performing complete soil and plant tissue analyses of the plants we measured, and they will share the results with us when completed. Correlations between soil contaminants appearing in the soil analysis and characteristics of the fluorescence spectra and images will be discussed in the final report, as will correlations between applied chemicals and LIFI/LIFS data.

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Plant Stress Analysis Technology Transfer

Objective

The Hemispheric Center for Environmental Technology at Florida International University (FIU-HCET) will aid the transfer of the laser-induced fluorescence imaging (LIFI) technology to the agricultural private sector through a market survey. The market survey will help identify the key eco-agricultural issues of nations that may benefit from the use of sensor technologies developed by the OST. The principal region of interest will be the Western Hemisphere, particularly the rapidly growing countries of Latin America and the Caribbean.

HCET will assess LIFI's advancement with respect to the state of the art. It will also facilitate the recruitment of commercial partners. These partners will likely be existing providers of agricultural services in the region or service providers who wish to expand their businesses into the Latin American and Caribbean markets. The targeted outcome of this work is to facilitate the technology's implementation by a commercial entity.

Progress

In October, HCET personnel completed the following tasks:

- Generated a matrix of the five countries' six primary crops in metric tons and primary exports in metric tons and in monetary amount.
- Located several global agricultural associations and organizations as well as several international agricultural Web sites.
- Identified potential concerns or problems in reference to the general Latin American agricultural regions.

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Environmental Remote Sensing for Monitoring Plant Health (EPCOT)

Objective

Optical characteristics of plants are being measured to detect stress as an indicator of underlying problems such as chemical contamination of soil or groundwater at the DOE and other sites. This project will apply the results of those measurements to construction of a robot-mounted suite of remote sensors for greenhouse installation and testing at EPCOT Center in Walt Disney World.

The project will involve a public demonstration of DOE technology; DOE-industry and government interagency cooperation; and technology transfer, i.e., to the agricultural community. The final application of this technology will be remote monitoring of DOE sites for detection of uranium oxides and plant stress monitoring. Vegetational sites include clay caps and landfills, while uranium surveys include monitoring decontamination and decommissioning (D&D) sites.

Progress

The first experiment to determine the effects of light-dark cycles on fluorescence signatures in plants began in the environmentally controlled lab at The Land in EPCOT. Fluorescence spectra from several crop species (beans, soybeans, wheat, and peppers) that have been dark adapted for hours will be compared to spectra from fully illuminated plants. Results will help determine the best sampling times for future fluorescence spectrophotometer and laser-induced fluorescence imaging (LIFI)/laser-induced fluorescence spectroscopy (LIFS) system measurements and ultimately for real-world remote sensing measurements. Differences among shaded and non-shaded leaves, as well as among trifoliate leaves of beans and soybeans, will also be investigated. Plants were seeded for these tests.

The first harvest of the bean/zinc experiment was conducted earlier this month. Two varieties were grown in pure silica sand and irrigated with a full nutrient solution with

levels of zinc ranging from 0 to 40 ppm. Plants grown with 0-ppm zinc exhibited visual stress, but the others were normal in appearance. So far, it appears that fluorescence in general goes down in Zn-deficient plants and goes up in the 40-ppm treated plants.

The Princeton Instruments camera system (part of the LIFS system) that was used in Poland was shipped back to the manufacturer for repair of some problems that were encountered with it in the field.

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Program Coordination

Characterization Crosscutting Program Field Coordination

Objective

This project provides field coordination and program support for Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP) activities. It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of technology integration; assessment of technology development opportunities; and program planning and implementation.

Progress

Focus Area review. As mentioned last month, in response to the Technology Action Plan outlined in Mr. Al Alm's memo of July 3, the OST scheduled a comprehensive review of all technology development projects at each Focus Area host site. In October, the CMST team organized and forwarded information materials from two CMST-funded projects grouped with the Decontamination and Decommissioning Focus Area and seven CMST-funded projects grouped with the Tanks Focus Area (TFA) to those groups, respectively, for their use at the reviews scheduled for November.

Cost savings tasks. Paul Wang issued a memo regarding the cost savings analysis task to Stan Wolf, Pramod Mallick, the CMST team, and the cost savings teams on October 20. The memo discussed the success of the collaborative efforts between the CMST team and the cost savings teams, the status of the task, and follow-up action items. A table summarizing the status of the cost savings analysis reports was attached to the memo.

Stephan Weeks submitted the cost savings reports for BetaScint and Digface (alias Warthog) and sent the reports for review by the PIs and for comments by the Subsurface Contaminants Focus Area (SCFA) points of contact and technology end users. He continued to coordinate the effort to facilitate deployment of BetaScint at PANTEX to obtain valuable and accurate cost savings data for the development of the BetaScint Innovative Technology Summary Report (ITSR). He also communicated with Mike Hogan of MSE, who performed a cost savings report on Digface with respect to waste volume reduction vs. characterization. Weeks continued discussions with Arnie McCoy of the U.S. Army Corps of Engineers who performed the cost savings analyses for both technologies.

Dave Roelant worked on the final drafts of cost savings analyses for two technologies and distributed the analyses to the DOE field offices for comments.

Facilitator activities:

In his role as facilitator, Roelant obtained updated materials on the "Electrical Resistance Tomography" and the "Portable X-ray, K-edge Heavy Metal Detector" projects.

In his role as facilitator, Weeks worked with several projects:

- "Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment" project—discussed the results of two recent field demonstrations and planned FY98 work
- "Process Monitoring and Control: Ammonia Measurements in Offgases" project—discussed the closure of the project and the status of the system delivered to Savannah River Site for implementation in pre-processing of Defense Waste Processing Facility (DWPF) wastes
- "Neural Network Raman Cone Penetrometer Signal Extraction and Enhancement" project—discussed closure of the project and the progress of the contract to perform work at Hanford in a Hot Cell and also to perform chlorinated hydrocarbon plume characterization via a cone penetrometer Raman probe at Savannah River; the final Neural Network package will be delivered to Hanford Numatec and to the PI by February 1998
- "Development of a Multielement Metal Continuous Emissions Monitor for Compliance" project—discussed a recent field demonstration, installation of the HiRIS in the air -inductively coupled plasma system at the Diagnostic Instrumentation and Analysis Laboratory, and the FY98 work targeting an alpha continuous emissions monitor

Technical monitor activities. In his role as a technical monitor, Stephan Weeks reviewed the Phase I/Phase II option and Gate 4 review materials for FETC for the project entitled "Automated Monitoring System for Fluid Level and Density in High-Level Waste Tanks."

Support for defining requirements for evaluation and testing of radiological sensor and robotic platform techniques. The report for the long-range alpha detector is complete and will be submitted on time. The report for nondestructive assay/nondestructive examination will be delayed until the third week of November to obtain agreement with the Mixed Waste Focus Area and the Stored Waste Examination Pilot Plant (SWEPP) at Idaho National Engineering and Environmental Laboratory. Stan Wolf was informed of the delay and is in agreement with the schedule.

Paul Hurley attended a meeting of the heavy metals project on October 29, where a number of successes were reported. These included the pilot plant for dirt decontamination at Ashtabula, segmented gate system applications at West Valley and

Sandia, and a Uranium extraction pilot plant at Mound Laboratories. The most important factor is that several projects are in progress, rather than in the discussion stage.

Support for program management:

- Wang and Roelant assisted in preparing presentation materials regarding the DOE Nevada Operations Office (DOE/NV) FY98 CMST-CP program management plan. David Hippensteel, CMST-CP field program manager, is scheduled to present the materials to Jef Walker, EM-53, in early November. The presentation materials include an overview of programmatic and technical activities, FY97 accomplishments, planned FY98 accomplishments, and DOE/NV strengths and commitments.
- At the request of Kurt Gerdes of EM-53, Wang prepared the FY98 performance plan for the CMST field coordination project and forwarded it to him on October 30.
- Roelant participated in four weekly Nevada Operations Office Site Technology Coordination Group (STCG) Steering Committee meetings and in four conference calls for the national STCG organization. He also continued discussions with STCG committees at all DOE field offices regarding technologies applicable to their needs and therefore remaining in the "Linkage Tables."
- As assigned, Weeks began work on updating visuals (photographs, schematics, etc.) for the OST Information for Decisions (IFD) Visuals Collection. After contacting the CMST team for input, Weeks began collecting electronic visual files with the assistance of the CMST student intern.
- Roelant drafted information related to programmatic support activities at DOE HQ for the CMST-CP. He also collected and drafted material for the Project Baseline Summary (PBS) submission for the CMST-CP. In addition, he provided a cost breakdown of CMST-CP funding for technology development for each of the four EM-50 Focus Areas.
- Wang communicated with Jane Denne of the U.S. EPA Characterization and Monitoring Branch (CMB). Wang forwarded information materials about the CMST-CP to Denne and expressed the CMST-CP's interest in exploring potential collaborative activities with the CMB.
- The Special Technologies Laboratory CMST team participated in a conference call with the CMST-CP team at the request of David Hippensteel.

Technical information requests. At Carol Eddy-Dilek's request, Tiffany Zachry, PAI, forwarded a file containing sections of the final Focus Area review presentation materials to her on October 30.

CMST Internet site development. In early October, Weeks visited Krell Institute to discuss issues regarding the CMST-CP Internet site. Krell has established a password-protected web site as the development area for new features including (1) searches of the CMST-CP web site, project baseline summaries, and Site Technology Coordination Group needs and (2) a query that generates customized reports using the CMST monthly progress reports. These features will be transferred to the public site when development is complete. Further developments to improve communication resources for the national CMST-CP team using web-based management tools were also discussed with Krell.

The CMST Internet site domain name has been transferred from Ames Laboratory to Lighthouse Communications, making the site accessible using only the www.cmst.org address. Weeks drafted a purchase requisition for a web service provider for FY98 and is continuing work on the CMST-CP Vendors database (accessible from the CMST Internet site).

Hardcopy and electronic publications:

- Weeks and Zachry prepared the September CMST Monthly Progress Report, including highlights, and distributed 72 hardcopies to DOE managers and other interested parties. The report is also posted on the CMST Internet site (www.cmst.org).
- Zachry submitted highlights regarding CMST-related activities for consideration of inclusion in the OST Weekly Highlights publication.

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Characterization Crosscutting Program Technical Support

Objective

This task provides technical support and assistance in field coordination and program support for the Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP). It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of technology integration; assessment of technology development opportunities; and program planning and implementation. Bill Haas and Glenn Bastiaans work as members of the combined DOE Headquarters (HQ) and field CMST-CP management and implementation team, providing technical and other support, as directed, to the CMST-CP HQ Program Manager and the CMST-CP Program Coordinator.

Progress

CMST-CP technical support to the Mixed Waste Focus Area (MWFA):

- Haas attended the MWFA Projects Review meeting in Idaho Falls on October 14 and 15. During the review, he provided technical support for reviewer questions concerning continuous emissions monitoring and process monitoring for mixed waste treatment.
- Haas assisted Nick Soelberg, Lockheed Martin Idaho Technologies Co. (LMITCO), in preparing "Air Pollution Control Status and Needs for Thermal Treatment Systems," a presentation for the November meeting of the National Technical Workgroup for Mixed Waste Treatment. The presentation is co-authored by Soelberg and Peggy Knecht of LMITCO and Haas. Soelberg is the lead author and presenter.
- *Performance testing of multi-metals continuous emissions monitors (CEMs).* Haas continued work, including extensive collaboration with Nina Bergan French, Sky+, Inc., and Jeff Ryan, EPA Research Triangle Park (RTP), on the report of the April 1996 multi-metals CEMs test, "Performance Testing of Multi-Metal Continuous Emissions Monitors."
- Haas provided written input for the presentation, "EPA/DOE Field Test Results of Continuous Emissions Monitors," to be given November 6 at the meeting of the National Technical Workgroup on Mixed Waste Treatment. The co-authors are Dan Burns, Westinghouse Savannah River Co. (WSRC); Haas; Steve Priebe, LMITCO; and Nina Bergan French.
- With Nina Bergan French, Dan Burns, Steve Priebe, and Paul Lemieux and Jeff Ryan of the EPA, Haas submitted an abstract of a paper, "Results of the September 1997 DOE/EPA Evaluation of Multi-Metal Continuous Emissions Monitors," on October 17 for the 1998 International Conference on Incineration and Thermal Treatment Technologies.
- In September, Haas assisted in the analysis of data from the side-by-side performance testing of seven multi-metal CEMs and two CEM-support technologies at the EPA rotary kiln incinerator simulator facility. This month, in preparation for publication of the test results, Haas provided Nina Bergan French with a proposed rewrite and clarification of the equations and narrative for the Relative Accuracy calculation. French has the lead for data analysis and reporting for the 1997 tests.
- Haas initiated discussions with David Hutchins, DOE Oak Ridge, and Russ Gritzo, Los Alamos National Laboratory, regarding intent to deploy the flow through alpha monitor for continuous emissions monitoring at the Toxic Substances Control Act (TSCA) incinerator at Oak Ridge.

- *Incinerator operators' meeting.* Haas provided written input and feedback to David Eaton, LMITCO, regarding the proposed agenda for the special DOE/DOE contractor meeting on November 4, immediately preceding the National Technical Workgroup meeting. The purpose of the meeting is to ensure that the operators of the existing DOE incinerators have an opportunity to identify any problem areas that need to be addressed to ensure compliance with the EPA proposed Maximum Achievable Control Technology (MACT) rule.

CMST-CP technical support to the Tanks Focus Area (TFA):

- Glenn Bastiaans coordinated the assembly of informational material to support the review of seven CMST projects at the TFA Projects Review meeting to be held November 18 to 20. He communicated with all the CMST facilitators for the projects as well as some of the PIs. Coordination was also done with Steve Schahlta and Tom Thomas of the TFA. The TFA will use the informational material to prepare overheads for presentation at the review. TFA product line managers will present the CMST material at the review. Bastiaans will preview all overheads on CMST technical task plans and will attend the review.
- Bastiaans completed a final revision of a manuscript entitled "Vadose Zone Characterization for High Level Waste Tank Closure" in collaboration with John Ballard and Cliff Morgan of the Waterways Experiment Station. The manuscript will be published by Plenum as part of an American Chemical Society Symposium Proceedings monograph.

CMST-CP technical support for FETC Program Research and Development Agreement (PRDA)/Research Opportunity Announcement (ROA) project management. Haas provided information to C. Eddie Christy, FETC, concerning the performance of the continuous emissions monitor based on spark induced breakdown spectrometry (SIBS) fielded by Physical Sciences Inc. during the September CEM tests at the EPA RTP. The additional information regarding performance was sought as input for a DOE decision regarding funding for the PSI Phase III PRDA proposal entitled "Portable Sensor for Hazardous Waste."

CMST-CP support to the Technology Information Exchange (TIE) workshops. Haas provided written input to Sherie Earle ten Hoope, Advanced Technologies and Laboratories International, and Lawnie Taylor, EM-43, for their consideration regarding the TIE Workshops Mission and Vision statement and the agenda for the TIE Workshop Lessons Learned and Preplanning Meeting.

Support for CMST-CP program management:

- To support review of CMST projects at the Subsurface Contamination Focus Area (SCFA) Projects Review meeting October 7 to 9, the MWFA Projects Review meeting October 14 to 17, and the TFA Projects Review meeting November 18 to 20, Haas and Bastiaans provided information on Site Technology Coordination Group (STCG) needs and Project Baseline Summaries (PBSs) and assembled other information materials provided by the PIs. The information for the SCFA review was provided to Tiffany Zachry, PAI. The information for the MWFA review was provided to Steve Priebe. The MWFA package included a table identifying the PI and organization, development project or activity title, and sponsor for 19 currently funded projects (DOE EM and other sponsors) that have applicability to DOE mixed waste treatment process and emissions monitoring needs. Additional information regarding the TFA Projects Review meeting was presented above.
- As requested by Caroline Purdy, CMST-CP HQ lead, on behalf of Grover Chamberlain, EM-50, Haas provided information regarding X-ray fluorescence equipment for metals in soils to Dr. Robert W. Gerlach, Staff Scientist, Lockheed Martin Environmental Services, Las Vegas. The equipment described was tested and verified for site characterization by the EPA.
- Haas and Bastiaans participated in the October 29 CMST-CP conference call during which management organization and current activities were discussed.
- As requested by David Roelant of the CMST-CP support team, Haas and Bastiaans provided constructive comments and input for the draft CMST-CP contribution to the DOE-EM PBS for the OST.
- Bastiaans continued discussions with the Hemispheric Center for Environmental Technology (HCET) at Florida International University (FIU) concerning planning of FY98 HCET projects intended to support CMST and the possibility of enhanced collaboration between HCET and CMST.
- Bastiaans and Haas prepared lists of FY97 CMST accomplishments and planned accomplishments for FY98. This material will be used to support a CMST-CP field management presentation to DOE HQ.
- Bastiaans provided an email memo briefing David Hippensteel, CMST Field Manager, on plans for tank slurry monitoring technology deployment for FY98 and on liaison activities with HCET at FIU.
- Haas continued to support the preparation of cost savings analysis reports for the deployment of innovative technologies. Please see last month's report. For the draft cost analysis report for Direct Sampling Ion Trap Mass Spectrometry (DSITMS), Haas secured constructive written comments from Carol Eddy-Dilek and forwarded those to the cost analyst, Jay Gunderson, Energy and Environment Research Center, University of North Dakota. Haas also provided a list of sites

where DSITMS has been demonstrated or used in actual field screening applications. For the draft cost analysis report on the use of continuous emissions monitors, Haas provided Gunderson with constructive written review comments and an electronic copy of the paper "Demonstration of Multi-Metals Continuous Emission Monitors for Real-Time Measurement of Trace Hazardous Metals." The paper reports on the April 1996 multi-metals CEM tests at the EPA RTP. It is to be published in the proceedings of the Electric Power Research Institute (EPRI) International Conference on Managing Hazardous Air Pollutants, November 1997.

- Bastiaans initiated activities to identify site advocates for two CMST-supported innovative technologies, fast gas chromatograph (GC) with surface acoustic wave (SAW) detection (Electronic Sensor Technology) and the enhanced spectral gamma probe for deployment with cone penetrometers. Cost savings studies for both technologies were reviewed along with the Innovative Technology Summary Report (ITSR) booklet for the GC-SAW technology. Contacts with potential DOE field users of the technologies are being initiated.

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